

The Orbit of γ Andromedæ BC. By S. W. Burnham, M.A.

For nearly forty years after the discovery of this pair by Otto Struve in 1842, the measures failed to show any considerable change in either angle or distance. The observations are very discordant, and for many years it was impossible to say anything more than that an increase in the distance of perhaps one or two tenths of a second was probable; while change in the angle was at least doubtful so far as the measures were concerned. Some ten years ago it was evident that the distance was decreasing, and it finally came to be regarded as single in most telescopes. I found it very close with 36-inch refractor at Mount Hamilton, but made some measures of both angle and distance in 1889, and again in 1891 obtained three fairly satisfactory measures of the angle, the distance being estimated at not more than $0''.05$. It was also examined in 1888 and 1890, but the star was too close, or the conditions too unfavourable, to make it possible to get any measures.

From the uncertain and discordant character of the earlier measures, it was impossible to tell to which quadrant the smaller component belonged in my measures of 1891, and therefore the form of the apparent orbit was still uncertain. During the past summer I requested Professor E. E. Barnard to observe this pair with the 36-inch telescope, and especially to be certain of the quadrant. I have recently received from him his measures, made on two nights under favourable conditions. On both occasions he was absolutely certain that the smaller component was on the following side. The stars were well separated with a power of 2,600, and the difference in magnitude was unmistakable. I have given the highest value to these measures.

This position furnishes the key to the situation, and without it would be impossible to even guess at the form of the apparent orbit. With the large arc passed over by the smaller star, a reasonably good provisional orbit should now be obtained. According to the Mount Hamilton measures, this star has moved about 330° in the last four years.

The following are the measures of this pair :

Measures of γ Andromedæ BC. (O Σ 38).

1843.00*	119.7	$0''.45 \pm$	2n	Dawes
•19*	119.8	0.35	2-1	Mädler
•55*	125.5	0.48	3	O. Struve
1845.15*	116.9	0.39	4	Mädler
1846.64*	111.3	0.43	7-3	Mitchel
1847.13*	117.9	0.52	5	O. Struve

1847.82*	111.3	0.6 ±	4 ⁿ	Dawes
1849.69*	114.9	0.47	4	O. Struve
1851.19	116.6	0.40	4	Mädler
1852.21*	114.5	0.48	2	Mädler
.78*	111.3	0.5 ±	2	Jacob
1853.23*	116.0	0.47	3	Mädler
.79*	108.5	0.55 ±	4	Dawes
.94*	106.8	0.4 ±	4	Jacob
1854.75*	112.0	0.61	1	Dawes
1855.02*	119.4	...	1	Mädler
.09*	109.8	0.40	1	Secchi
1856.12*	116.7	0.5 ±	1	Jacob
.20*	116.5	0.45	1	Mädler
.21*	121.7	0.41	2	Winnecke
.84*	113.0	0.67	3	O. Struve
.90*	109.7	0.47	3	Secchi
1857.23*	115.4	0.45	3-1	Mädler
1858.06*	114.0	...	2	Jacob
.22*	115.4	...	2	Mädler
.99*	108.9	0.45	3	Secchi
1859.81*	108.7	0.53	1	Dawes
1862.55*	115.2	0.50	4-2	Mädler
1863.27*	108.5	0.45 ±	8	Dembowski
.86*	107.7	0.59	1	Dawes
.99*	107.6	0.61	...	Romberg
1865.67*	107.1	0.59	4	Knott
.68*	106.9	0.60	1	Dawes
.76*	106.3	0.58	2-1	Talmage
1886.21*	110.0	0.70	3	O. Struve
.74	132.3	...	1	Winlock
.74	107.2	...	1	Searle
.74	100.4	...	1	Winlock
.85	104.2	0.64	1	Talmage
1867.79	104.3	0.5 ±	1	Newcomb
1868.82*	102.0	0.69	6-5	Brunnow
1869.84*	107.0	0.63	3	O. Struve
.95*	105.6	0.5 ±	13	Dembowski
1871.01*	110.6	0.63	15	Dunér

Dec. 1893.

of γ *Andromedæ* BC.

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1872·83*	101°5	0°63	4-2n	Brunnow
·92	91·8	0°5 ±	2-1	Wilson & S.
1873·17*	105·4	0°63	5	O. Struve
1874·00*	109·3	0°53	1	Newcomb
·53	96·3	0°51	2	Gledhill
1876·79	105·7	...	1	Wilson & S.
1877·05*	104·1	0°48 ±	6	Schiaparelli
·71	103·9	...	1	Doberek
·94	102·4	0°84	1	Seabroke
1878·21*	101°0	0°36	8	Hall
·65*	102·1	0°43	2	Burnham
1880·06*	107·9	0°36	1	Burnham
·11	106·7	...	2	Seabroke
·12	94·1	...	8	Jedrzejewicz
1882·05*	104°0	0°49	6-1	Bigourdan
1883·15*	93·1	0°29	7	Engelmann
·16	106·7	...	1	Seabroke
·87*	103·1	0°40	2	Perrotin
1884·18*	113·3	...	3	Seabroke
·65*	117·6	0°35	1	Perrotin
1886·83*	101°0	0°29	1	Newcomb
1889·51*	98·2	0°09	1	Burnham
1891·72*	312·6	0°05 ±	3	Burnham
1893·71*	123·4	0°12	2	Barnard

Mr. Gledhill, in his *Handbook of Double Stars*, gives two measures of this pair by Challis as follows :

1842·84	106°3	0°15
1843·31	115·8	0°31

I have not been able to refer to the original publication containing these observations, but as one of the angles must be erroneous, and the distances impossible, I have omitted them in the foregoing table.

The measures shown on the accompanying diagram (Plate 4) are marked with an asterisk (*), and the consecutive positions connected by lines to show the order of time in which the observations were made. When more than one observation in a year is used, a simple mean is taken. It will be seen at once that the measures as a whole are inconsistent and uncertain to an extraordinary degree. Evidently some of them are little, if any,

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better than careful estimates. The distances in this instance seem to be almost as doubtful as the angles, which is very unusual in a pair of this kind. These large errors are all the more remarkable for the reason that from the beginning of the observations down to less than ten years ago this has been a comparatively easy pair, even with telescopes of very moderate aperture.

In finding the apparent orbit, it has been necessary to be governed largely by the more recent measures. After various trials, the ellipse shown on the diagram was adopted as the best that could be found to satisfy the law of areas in respect to the intervals between the late measures and the general group of earlier positions. It is satisfactory in this respect, and should give as good approximate elements as can be found from the present data.

From the apparent orbit we have the following elements :

$P = 54.8$ years	$i = 78^{\circ}.9$
$T = 1892.1$	$\Omega = 113^{\circ}.5$
$e = 0.875$	$\lambda = 200^{\circ}.8$
$a = 0''.37$	

Apparent Orbit.

Length of major axis	=	$0'.697$
Length of minor axis	=	$0''.077$
Angle of major axis	=	$110^{\circ}.0$
Angle of periastron	=	$289^{\circ}.3$
Star from centre	=	$0''.30$

According to this orbit, the distance should steadily increase, the position-angle changing very slowly from year to year. It will soon be readily measurable with ordinary refractors.

Chicago ;
1893 November 15.

Windsor Measures of α Centauri in 1893. By John Tebbutt.

The following measures of α Centauri were taken with the 8-inch equatorial at the request of Professor T. J. J. See, of Chicago. As there will probably be no other double-star observations from this observatory for the current year, I deem it advisable to send them at once for publication in the *Monthly Notices*. In all the observations east of the meridian the line joining the observer's eyes was parallel to that joining the components, but in those west of the meridian these lines were at right angles. The scale of weights is from one to five, one denotes the worst, and five the best conditions possible.

Date of Obs.	Position Angle.	No. of Obs.	Distance.	No. of Obs.	Mag. Power.	Hour Angles between which the measures were made.		Weight 1-5.
1893.		"	"			h m	h m	
411	...	...	20'42	10	170	2 45 E	2 20 E	2
411	206'3	10	...	...	230	1 53 E	1 40 E	2
416	207'0	10	...	...	230	0 25 E	0 10 E	2
419	206'8	10	20'02	10	230	2 31 E	1 51 E	3
422	206'3	10	20'25	10	300	3 20 E	2 46 E	4
427	206'9	10	...	...	300	0 29 E	0 0	4
430	207'1	10	20'59	7	300	2 31 E	1 40 E	4
493	207'7	10	20'60	8	300	1 53 W	2 22 W	2
496	206'4	10	20'45	8	300	0 54 W	1 27 W	3
498	207'0	10	...	...	300	1 40 W	1 56 W	1
501	205'9	10	...	...	300	0 22 W	0 38 W	1

Weighting each result according to the conditions under which it was obtained, we have the following mean :

Epoch = 1893'442. Position angle = 206''8. Distance = 20''38.

*Private Observatory,
The Peninsula, Windsor, N.S. Wales :
1893 October 27.*

Observations of Double Stars made at Sydney Observatory.

(Communicated by H. C. Russell, B.A., F.R.S., Government Astronomer.)

The following list of double stars, believed to be new pairs, were found by Mr. R. P. Sellors between 1890 March and 1893 October, in the course of his double-star work with the 11½-inch refractor of Sydney Observatory.